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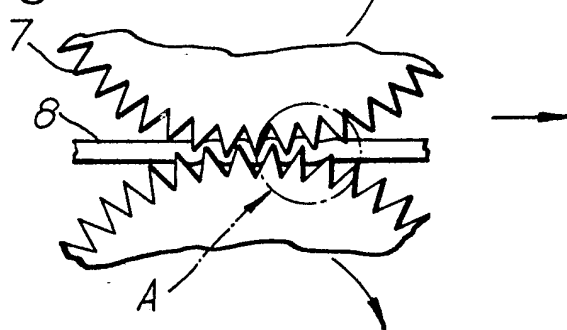
Sommerville

(54) Treating filter materials

(57) The invention provides apparatus for treatment of filter materials for use in dust proof masks or the like. With such filter material it is important that the dust collecting efficiency is enhanced and that its resistance to its gas/air penetration is reduced as much as possible to make breathing easier by the wearer. The invention is characterized by the apparatus

comprising at least one pair of carding rolls, each roll having cone or pyramid like protrusions 7 formed regularly over its surface and the said rolls providing a gap which is adjustable in relation to the thickness of a filter material web 8 passed therethrough, whereby the tips of said protrusions act on the material to make it fluffy for improved dust collecting efficiency and to reduce resistance to gas penetration.

Fig.3b.



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Fig. 1.

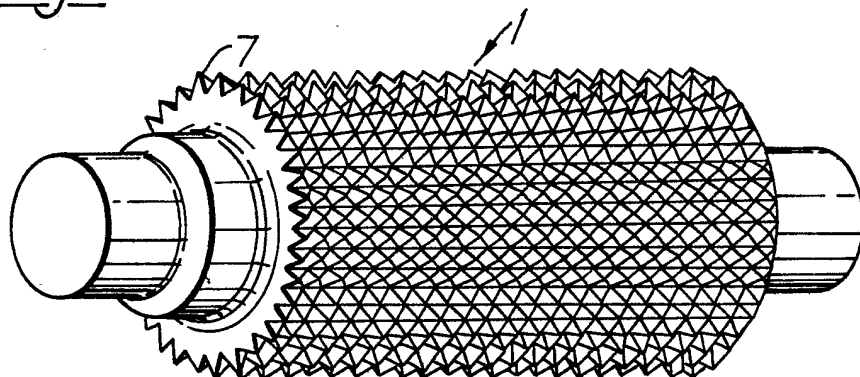


Fig. 2a.

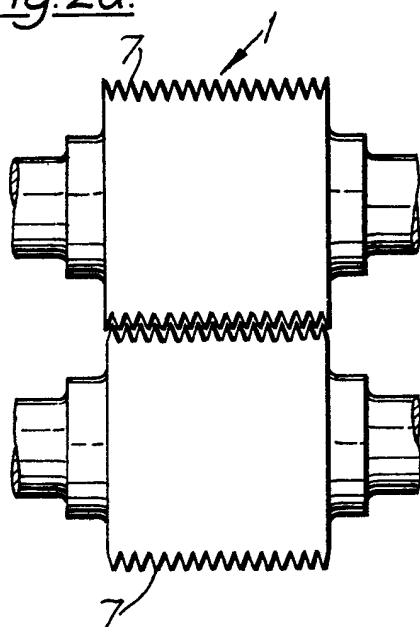


Fig. 2b.

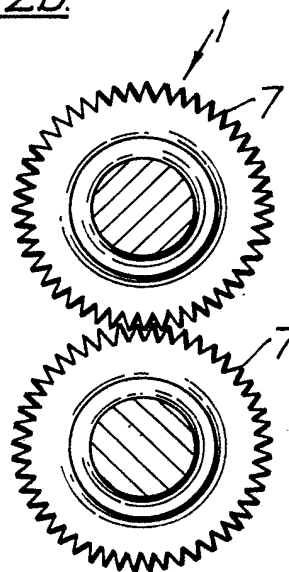
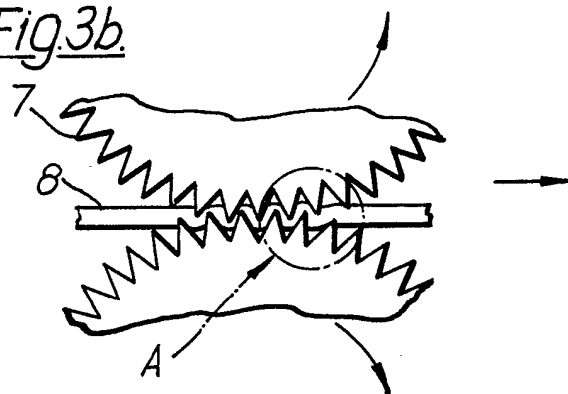
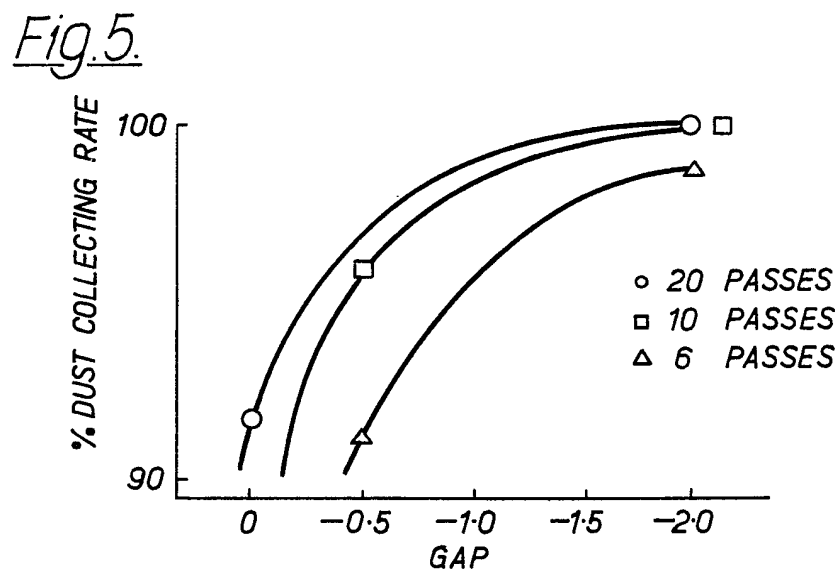
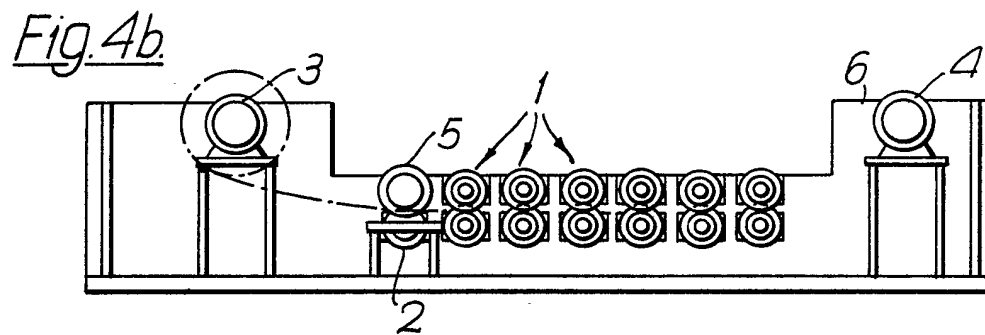
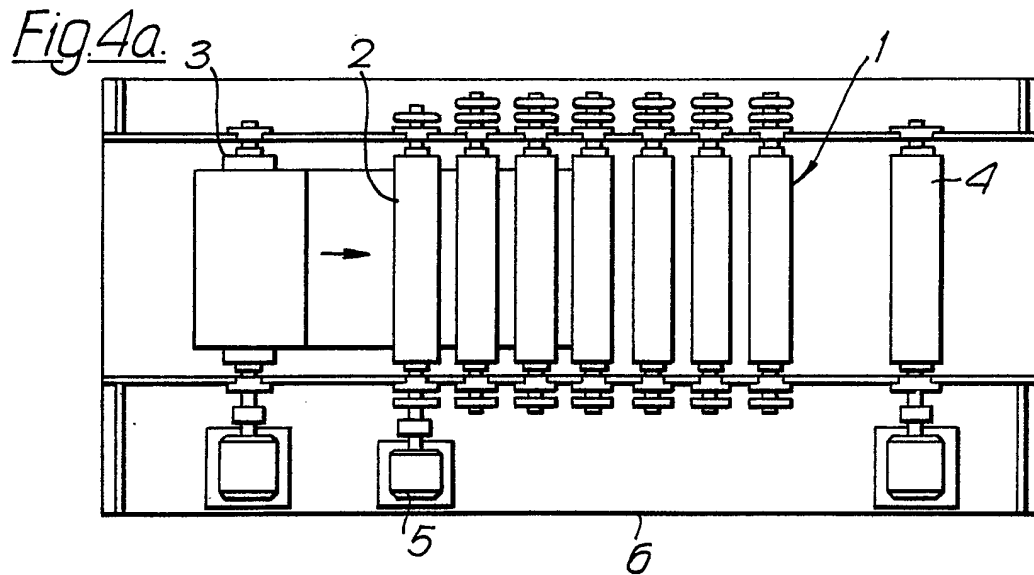


Fig. 3a.



Fig. 3b.





SPECIFICATION

Treatment of filter materials for use in dust-proof masks

The present invention relates to working treatment of filter materials for use in a dust-proof mask or the like.

5 In factories where large quantities of pulverized dust are generated as in the case of welding, casting and forging industries, wearing of a dust-proof mask is obligatory, and at present the filter for use in such a mask needs to be replaced every 1 to 3 days. 5

The Applicants have proposed in the Specification of their Japanese Patent Application No. 52—34997 a treatment process for greatly improving the dust collecting efficiency of a filter material for use in a dust-proof mask or the like in which the filter material is subjected to impregnation with synthetic resin, and having been dried, subjecting it to a tanning-equivalent working treatment by a physical method, such as by passing it through an apparatus in which rolls are disposed in a zig-zag manner. 10

As used herein the phrase "tanning-equivalent working treatment" means a working treatment effectly equivalent to the so-called tanning of leather which is performed through purely a physical process and which does not use any chemical agent such as tannin. 15

Unwoven webs consisting of chemical fibres of poly-propylene, rayon, acrylic resin, or the like either singly or in combination, woven webs, felt, foam rubber, urethane foam, etc can be used as the filter material.

20 With regard to the varieties of the synthetic resin to be impregnated, almost every resin such as vinyl acetate resin, acrylic resin, alkyd resin, polystyrene resin or phenolic resin can be used. 20

The process for the tanning-equivalent working treatment requires that the filter material be passed through the said apparatus for the purpose of improving its dust-collecting efficiency by generating fine cracks in the film-shaped resin on its fibres. In the tanning-equivalent working treatment of filter materials by means of such an apparatus, since the said material is maintained in a stretched condition so as not to sag between the rolls for the purpose of generating fine cracks in the film-shaped resin on the fibres of the said material, after tanning-equivalent treatment it is considerably deformed, and so, the apparatus has disadvantages in that the deformation results in difficulties with the process of cutting to a predetermined size after said working treatment and also the dust-collecting efficiency is too low. 25 30

An object of the present invention is to resolve the above-described problem and also to provide apparatus for tanning-equivalent working treatment having improved efficiency and performance.

According to the present invention, apparatus for the working treatment of filter materials for use in a dust-proof mask or the like, is characterized in that at least one pair of carding rolls are provided each roll having cone or pyramid-like shaped protrusions formed regularly on its surface, the rolls of each pair being arranged substantially parallel to provide an adjustable gap therebetween and so that their respective protrusions and recesses mesh with each other in said gap, the arrangement being such that the gap can be adjusted in relation to the thickness of a web of filter material passed therethrough whereby the tips of said protrusions pierce the web to cause the material to become fluffy and improve its dust collecting efficiency and to reduce its resistance to gas penetration. 35 40

Preferably a number of spaced pairs of carding rolls are provided to provide for a number of passes for a web of material fed therethrough.

Conveniently, the apparatus includes a pair of pinch rolls arranged to be driven and to feed a web of material through the pair or pairs of carding rolls, and may also include an uncoiler in front of a pair of pinch rolls, for supporting a spirally wound web of untreated filter material, and a take-up roll behind the carding rolls for taking-up the treated web of material, said uncoiler and take-up rolls being arranged to be driven substantially at the same speed as the pinch rolls. 45

In order that the invention may be readily understood and further features made apparent one preferred embodiment of apparatus for the tanning-equivalent working treatment of filter materials for use in a dust-proof mask or the like according to the present invention will be described with reference to the accompanying drawings in which:— 50

Figure 1 is a perspective view of a carding roll,

Figures 2a and 2b are schematic side and end views respectively of a pair of assembled carding rolls, illustrating the state of the filter material as it passes between the carding rolls.

55 Figure 3a and 3b are schematic side and end views respectively, 55

Figure 4a and 4b are plan and side elevations respectively and,

Figure 5 is a graph relating to the dust collecting rate of the apparatus.

Figure 1 illustrates one example of a carding roll for the tanning-equivalent working treatment having V-shaped grooves machined in both the axial and circumferential directions of the roll, at equal pitches over its entire surface, so that sharp protrusions 7 consisting of the tip portions of rectangular pyramids are arrayed regularly both in the axial and circumferential directions. As shown in Figure 2 a pair of upper and lower carding rolls 1 are assembled so that their respective protrusions and recesses mesh with each other both in the axial and circumferential directions, both the upper and lower rolls being adapted to be driven. Referring now to Figure 3 as the filter material 8 is passed between the 60

carding rolls 1 it is deformed into a finely corrugated state whilst being pressed in both the axial and circumferential directions, and thereby the resin is widely distributed onto the filter material. In addition, since the tip end of the protrusions 7 on the surfaces of the carding rolls are quite sharp, they pierce into the filter material 8 as it passes between the rolls, and through the outlet side (referenced A) of the rolls.

5 When the tip ends of the said protrusions release from the filter material, they effect a pulling and tearing action to make the filter material fluffy. Due to the fluffy nature of the material so produced, the dust collecting efficiency of the filter material is improved, and its resistance to air permeation is reduced so that any undue difficulty in breathing by the wearer is alleviated. 5

Referring to Figure 4 the working treatment apparatus comprises a mounting frame 6 supporting the carding rolls 1 as well as a pair of pinch rolls 2, an uncoiler 3, a take-up roll 4 and a drive motor 5 for the pinch rolls 2. 10

The disposition and functions of the components of the present invention are as follows:

A plurality of pairs of carding rolls 1 are spaced along the frame 6 to provide a number of stages for treatment of the filter material 8. The pinch rolls 2 are arranged to be driven by the motor 5 for feeding the filter material and are provided in front of the carding rolls 1. The uncoiler is disposed in front of the pinch rolls 2 and is intended to support spirally wound webs of untreated filter material; said uncoiler is arranged to be rotated by a further motor at the same speed as the pinch rolls 2 for assisting the feeding by said pinch rolls. The take-up roll 4 provided for winding up the treated filter material 8 is provided behind the carding rolls and is also arranged to be driven by a motor preferably at the same speed as the pinch rolls and uncoiler. If the apparatus for associated processes before and after the tanning-equivalent working treatment process are arranged in a line, then either or both the uncoiler 3 and the take-up roll 4 are unnecessary, since it becomes possible to feed from one apparatus directly to the next. For example, the working treatment apparatus could be connected directly to apparatus for cutting the filter material into predetermined lengths in which case the feed-in of this apparatus would render the take-up rolls 4 unnecessary. 15 20 25

An example of a treatment process and apparatus therefore in accordance with the invention will now be described:

The filter material comprising a mixed woven web consisting of 80% polypropylene and 20% rayon was vacuum-impregnated with a vinyl acetate resin emulsion. Excess liquid was squeezed out by means of rolls, and the filter material was dried with a hot blower type of dryer, set at 105°C. The dried filter material was passed through the above described working treatment apparatus and the treatment was performed whilst varying the gap between the carding rolls as well as varying the number of times the filter material was passed between the rolls. As a result of measuring the relationship between the dust-collecting rate as well as the resistance to gas penetration in the respective cases, the following data was obtained: 30 35

Type of Pulverized Dust: stearic acid fumes

Test Duct Filter Area: 3.3 m²

Linear Speed: gas quantity 1l/min

Method of Measurement: Piezo-balance type dust meter made by Nihon Kagaku Kogyo Co. 2 sets

40 The relationship found between the dust collecting rate and the gap between the rolls is shown in Figure 5, whilst the relationship between the number of times the material was passed between the rolls and the resistance to gas penetration (expressed as a pressure loss) is shown in the following table. The gap in this case was (—2 mm): 40

	No working treatment	3 Passes	5 Passes	10 Passes
Resistance to Air Penetration H Pressure loss (mmHg)	34	30	26	24

45 Results of Measurement 45

As shown in Figure 5, the dust collecting rate was improved by increasing the number of passes of the material between the rolls and by reducing the gap between the rolls. It will be seen that the best result was obtained with 20 passes and a gap of about —2 mm. Furthermore, as will be apparent from the above table of pressure loss, the resistance to gas penetration is progressively lowered the more times the filter material is passed between the carding rolls 1. By employing apparatus according to the present invention a filter material can be produced having a high dust-collecting efficiency and a small resistance to gas (and air) penetration and by careful selection of the number of pairs of carding rolls, to produce the required number of passes over the filter material, said working treatment can be effected as a continuous process. 50

55 It will be appreciated with regard to the gap that "O" refers to a datum position where the tips 7 of the pyramids just touch the web of the material passed therethrough; thereby any adjustment of the gap from this datum position to bring the tips 7 of the pyramids towards each other is an effective reduction of said gap and is given a —ve notation above and in Figure 5. 55

CLAIMS

1. Apparatus for the working treatment of filter materials for use in a dust-proof mask or the like; characterized in that at least one pair of carding rolls are provided each roll having cone or pyramid-like shaped protrusions formed regularly on its surface, the rolls of each pair being arranged substantially parallel to provide an adjustable gap therebetween and so that their respective protrusions and recesses mesh with each other in said gap, the arrangement being such that the gap can be adjusted in relation to the thickness of a web of filter material passed therethrough whereby the tips of said protrusions pierce the web to cause the material to become fluffy and improve its dust collecting efficiency and to reduce its resistance to gas penetration. 5
2. Apparatus according to Claim 1, characterized in that a number of spaced pairs of carding rolls are provided to provide for a number of passes for a web of material fed therethrough. 10
3. Apparatus according to Claim 1 or Claim 2, having a pair of pinch rolls arranged to be driven and to feed a web of material through the pair or pairs of carding rolls.
4. Apparatus according to Claim 3, having an uncoiler in front of a pair of pinch rolls, for supporting a spirally wound web of untreated filter material, and a take-up roll behind the carding rolls for taking-up the treated web of material, said uncoiler and take-up rolls being arranged to be driven substantially at the same speed as the pinch rolls. 15
5. Apparatus for the working treatment of filter materials for dust-proof masks constructed, arranged and adapted to operate substantially as hereinbefore described, with reference to the accompanying drawings. 20